

**FINAL**

# **PHASE I RFI/RI WORK PLAN**

**ROCKY FLATS PLANT  
100 AREA  
(OPERABLE UNIT NO. 13)**

**U.S. DEPARTMENT OF ENERGY  
Rocky Flats Plant  
Golden, Colorado**

**ENVIRONMENTAL RESTORATION PROGRAM**

**OCTOBER, 1992  
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**Volume I of III  
Text**

**ADMIN RECORD**

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In order to minimize multiple reiterations of expensive color copies, only black and white copies were included in this submittal. If the changed figures are acceptable to CDH and EPA, final color copies will be transmitted within seven working days.



TITLE: DQOs

Approved By:

04/01/93  
Effective Date

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Manager

  /  /    
Date

## **5.0 DATA QUALITY OBJECTIVES AND DATA NEEDS**

### **5.1 DATA QUALITY OBJECTIVES**

Data Quality Objectives (DQOs) are established to define data needs for each of the RFI/RI tasks, coordinate collection activities to support those needs, and to assure the quality and quantity of resultant data. Collectively the data are used to make decisions regarding the risks the site poses to human health and the environment and to make decisions regarding which remedial measures are appropriate to mitigate the risks. DQOs are developed interactively with ongoing RFI/RI activities. The DQO development process is flexible, iterative, and dependant upon evaluation of existing data, and data that become available as a result of RFI/RI activities. Three stages are used in the development of DQOs, and each of the stages is outlined below (EPA, 1987)

#### **Stage 1 - Identify Decision Types**

- Identify and involve data users,
- Evaluate available data,
- Develop a conceptual model of the study site; and
- Specify RFI/RI objectives, and anticipate the decisions necessary to achieve the objectives

#### **Stage 2 - Identify Data Uses and Needs**

- Identify data uses,
- Identify data types,
- Identify data quality needs,

- Identify data quantity needs;
- Evaluate sampling and analysis options, and
- Review data precision, accuracy, representativeness, completeness, and comparability (PARCC)

### **Stage 3 - Design Data Collection Program**

- Assemble data collection components, and
- Develop data collection documentation

The DQO elements are continually revised and reevaluated on the basis of new data developed during each phase of the RFI/RI. As the environmental characteristics and the nature of contamination of the study area become better understood, additional data requirements will become apparent and both the DQOs and the Field Sampling and Analysis Plan (FSAP) may evolve in response to these requirements. The following discussion addresses each of the DQO elements.

## **5 1 1 Stage 1 Identification of Decision Types**

### **5 1.1.1 Identification of Data Users**

The following is a list of agencies and organizations that are the principal decision makers and end-users of data that will be generated during the OU 13 Phase I RFI/RI (ERP, 1991)

United States Environmental Protection Agency, Region VIII, Waste Management Division Director, Federal Facilities Branch Chief, and the Rocky Flats Remedial Project Manager.

State of Colorado Department of Health, Hazardous Materials and Waste Management Division Director, Hazardous Waste Section Leader, Hazardous Waste Facilities Unit Leader, and the Monitoring and Enforcement Unit Leader.

United States Department of Energy, Office of Environmental Restoration and Waste Management, Secretary of Energy, and the Acting Assistant Secretary for Environmental Restoration and Waste Management.

United States Department of Energy, Rocky Flats Office Manager, Assistant Manager for Environmental Management, and the Acting Environmental Restoration Division Director

EG&G Rocky Flats Plant, Environmental Management Department, Associate General Manager for Environmental Restoration and Waste Management, Environmental Management Department Director, Environmental Management Department Division Managers, and matrix project personnel from other Rocky Flats Plant or external EG&G organizations

EG&G Rocky Flats Plant technical specialists and subcontractors responsible for supervising, coordinating and performing Environmental Restoration activities (ERP, 1991i)

### 5 1 1.2 Evaluation of Available Data

Existing data are described in Section 2 of this document. Soils and geologic data collection activities in the vicinity of OU 13 have been primarily directed toward defining the RFP environmental setting. Much of the data were developed as a result of the RFP Geological Characterization including chemical data used to characterize the types and sources of contamination present in the soils and groundwater. Chemical data continue to be collected from monitoring well 4486 as part of the overall RFP characterization monitoring program. The available soils and geology data were not developed for the specific purpose of characterizing OU 13.

Existing ambient air monitoring programs characterize the RFP site on an area-wide basis for plutonium and americium. This data is not specific to any of the OU 13 IHSS sources, but provides a baseline for the RFP and is collected according to air sampling procedures specified in EMD Operating Procedures Manual No. 5-21000-OPS-AP, Volume VI, Air.

Surface water data (VOCs, metals, water quality, and radiochemistry) for OU 13 are available from seven sampling stations (SED118, SW018, SW019, SW020, SW022, SW023, and SW093). Four of the stations (SW019, SW020, SW022, and SW023) are located within OU 13, however, only SW019 is in a location that receives runoff from OU 13. The seven other surface water sampling stations receive runoff from other OUs.

Data for air quality, surface water, groundwater, soils, and geology are being validated in accordance with sections 3.4 and 3.7 of the QAPjP for data validation guidelines and data usability criteria respectively. Some of the data are validated and accepted, some are validated with qualifications, some have been rejected, and some have yet to go through the validation process. Appendices D, E, and F list the available analytical data and identify which samples have been validated. A summary evaluation of the data available for each IHSS located in OU 13 is given below.

**North Chemical Storage Site (IHSS 117.1)** This site was used to store non-radioactive construction debris, waste metal, and scrap metal. Existing data for this site are available from piezometers and groundwater monitor wells P114789, P214689, P115589, and P218089. The available data characterize the site's soils and geology. Limited surficial soils data was collected as part of a site-wide PCB investigation in 1991. This data shows no radionuclide contamination.

**Middle Chemical Storage Site (IHSS 117.2).** This site was used as a non-radioactive chemical storage facility. Existing soils and geologic data for this are limited to piezometers located in the vicinity of the site. These piezometers are P115589, P213689, and P214089.

**South Chemical Storage Site (IHSS 117.3).** This site was used as a storage area for pallets, cargo containers and new drums, and in one instance it is believed the site was used for the storage of a contaminated glovebox. Existing data for this site characterize soils, geology, and groundwater in the vicinity. These data are available from piezometers and monitor wells P313489, P418289, 6186. A radiometric survey for gross contamination was conducted for this area.

**Oil Burn Pit Number 1 Waste Leak (IHSS 128).** Approximately 200 gallons of radioactively contaminated waste oil were burned in an open pit in 1956. Data for soils and geology are available from piezometer P114889. Air monitoring data collected at the time the oil was burned may also be available.

**Lithium Metal Destruction Site (IHSS 134).** This area contains the reaction products from oxidation of magnesium and lithium metal coated with machine oils that may have contained

perchloroethylene Existing data for soils and geology are available from piezometers P114889 and P115489.

**Waste Spills (IHSS 148)** The soils of this site have reportedly been contaminated by spills of nitrates and possibly of unknown radioactive compounds Existing data for this site is limited to a radiometric survey for gross contamination and surface water sampling station SW019

**Fuel Oil Tank (IHSS 152)** This facility consists of an 800,000-gallon storage tank that is presently in operation, surrounded by an earthen dike, and containing No 6 fuel oil Approximately 700 gallons of fuel oil was spilled, cleaned up, and recycled in 1971 A similar spill of 400 gallons occurred in 1979 Existing data for this site is limited to a radiometric survey that indicated low levels of radioactivity were present.

**North Area Radioactive Site (IHSS 157 1)** This site is contaminated with unknown volumes of depleted uranium and beryllium. Existing data for this site include groundwater data from monitor well 4486, soil samples taken in the year 1953, and a radiometric survey for gross contamination

**Building 551 Radioactive Site (IHSS 158)** This site was used as loading area and as a temporary holding area for items contaminated with low levels of uranium. Existing data for this site include soils and geology data from piezometers P115589 and P214689. Limited surficial soils data was collected as part of a site-wide PCB investigation in 1991 This data shows no radionuclide contamination

**Waste Peroxide Drum Burial (IHSS 169)** This site is the reported location of a buried single 55-gallon drum of hydrogen peroxide This incident is probably the same incident described as IHSS 191. The evaluation of available data for IHSS 191 is given below.

**Solvent Burning Ground (IHSS 171)** This site was used for training fire-fighting personnel and may be contaminated with waste oil and gasoline Existing data characterizing this site's soils and geology are available from piezometer P114889

Valve Vault (IHSS 186) This was the site of a process waste line leak. Unknown volumes of liquid waste carrying radioactive constituents and other unknown chemicals leaked into the soil at this location. Existing data for soils and geology are available from piezometer P114789.

Caustic Leak (IHSS 190) This was the site of two leaks of sodium hydroxide from an above-ground storage tank. One of the leaks resulted in a release to the environment, and the other did not. There are no known sources of soils, geology, or groundwater data for this site. Surface water data is available from sampling station SW019.

Hydrogen Peroxide Spill (IHSS 191) This was the site of a release of hydrogen peroxide from a 55-gallon drum. There do not appear to be any sources of data for this site.

Scrap Metal Sites (IHSS 197) This IHSS was originally one of the Low Priority Sites—OU 16, but was transferred to this OU after the final work plan was submitted for comments. A description of the site is available in the Final No Further Action Justification Document, Rocky Flats Low Priority Sites (Operable Unit 16), July 1992. It overlaps and is adjacent to IHSS 117.1. Scrap metal components of early construction were reported to be buried in this area in the late 1950s or early 1960s. In 1981, during the construction of the new Protected Area perimeter fence, construction debris was discovered and work began to remove it. The material unearthed was moist, but not oily, scrap metal consisting of machine turnings, rings, shapes, overlays and other metal parts. The materials were monitored for radiation with a FIDLER, but none was detected. In addition, total long-lived alpha concentrations from three portable air samplers at the Building 559 cleanup area showed zero count. No transformers or related materials were found.

### 5.1.1.3 Site Conceptual Model

Conceptual models of IHSSs in OU 13 have been developed and are presented in Section 2.3 of this document. The models include a description of potential sources of contamination, release mechanisms, transport media, exposure routes, and potential receptors. The conceptual models were developed by organizing the IHSSs into two logical groups based upon the secondary source type, potential exposure routes and transport mechanisms. The two groups and the IHSSs that

compose each group are listed below. IHSSs 128 and 148 are listed in both groups because they each exhibit characteristics of both groups.

- Releases originating above ground and affecting surficial materials: 117.1, 117.2, 117.3, 128, 134, 148, 152, 157.1, 158, 171, 190, and 191.
- Releases originating and affecting transport media below the ground surface: 128, 148, and 186

The conceptual models will be an aid in identifying exposure pathways and to evaluate the potential risks to human health and the environment posed by the contamination present in OU 13.

#### 5.1.1.4 Data Objectives and Decisions

The DQO process requires that specific data objectives be defined, formulation of the objectives leads to the identification of data needs. The data objectives for the OU 13 RFI/RI Work Plan are summarized in Table 5.1. Data needs are expected to evolve based upon new information generated as the Work Plan is implemented. From the information generated by the RFI/RI, decisions can be made regarding whether remediation is necessary and which remedial alternatives would be appropriate.

#### 5.1.2 Stage 2 - Identify Data Uses and Needs

##### 5.1.2.1 Identify Data Uses

The principal uses of RFI/RI data have been defined in Data Quality Objectives for Remedial Response Activities and are listed below (EPA, 1987)

- **Site Characterization** - data are used to determine the nature and extent of contamination at a site,
- **Health and Safety** - data are used to establish the level of protection needed for onsite workers and to determine if there is imminent danger to the surrounding population,

- **Risk Assessment** - data are used to evaluate the threat posed by the site to public health and the environment;
- **Evaluation of Alternatives** - data are used to evaluate which remedial technologies may be appropriate;
- **Engineering Design of Alternatives** - data are used in the remedial design process to evaluate the performance of various remedial technologies;
- **Monitoring During Remedial Action** - after remedial actions are implemented, data are used to assess their effectiveness, and
- **Correlation of Environmental Contamination to Responsible Party(s)** - data are used to link wastes detected in the environment to wastes known to be onsite.

Data uses specific to RFI/RI Phase I sampling and analysis activities for OU 13 are listed in Table 5 2.

#### 5 1.2 2 Identify Data Types

Data types required for the OU 13 RFI/RI are air quality, soil engineering/geotechnical, soil-gas, soil chemistry, aquifer parameters, and groundwater chemistry. Table 5.1 provides additional information on the types of data that will be collected

#### 5.1.2.3 Identify Data Quality Needs

The level of data quality required for OU 13 RFI/RI activities is based upon the following factors: appropriate analytical levels, potential contaminants that may be present, level of concern and required detection limit. Each of these factors is discussed below.

Appropriate analytical levels for RFI/RI work are listed below (EPA, 1987)

- **Level I** Field portable instruments Results are typically not compound-specific or quantitative This analytical level is appropriate for providing real-time health and safety data and as a screening tool to indicate potentially contaminated areas.



Table 5.1 Phase I RFI/RI Analytical Data Quality Objectives

Specific Objective (Data Need)	Data Type	Sampling/Analysis Activity	Analytical Level	Data Use
Establish the presence or absence of contaminants	Soil gas, HPGs, soil and groundwater data	For each IHSS, conduct HPGe radiation survey, soil gas survey, collect surface soil samples, subsurface soil samples, and groundwater samples, and asphalt samples, as necessary	II for HPGe radiation survey, IV for conventional analytes, & V for radiological analytes	• Contaminant source and multi-media characterization
Characterize the environmental setting of each IHSS				
Subsurface stratigraphy and characteristics of subsurface materials	Geologic description	Evaluate applicability of existing data from adjoining IHSS's, drill boreholes and log subsurface materials	I	• Soil and Subsurface Characterization
Depth to groundwater	Water level data	Water level data from existing wells, piezometers and newly installed boreholes	I	• Subsurface Characterization
Groundwater flow regime	Water level data and aquifer tests	Evaluate applicability of newly developed aquifer data from adjoining Operable Units	I	• Aquifer Characterization
Vadose water flow regime	Soil moisture data and matric potential measurements	Evaluate applicability of newly developed vadose zone data from STP vadose characterization and the OU2 vadose study	I	• Vadose Zone Characterization
Characterize the nature and extent of contamination				
Affected media including location, concentration, type, physical state, and quantity of contaminants	Surface water, soil and groundwater data	For each IHSS, conduct HPGe radiation survey, soil gas survey, collect surface soil samples, subsurface soil samples, and groundwater samples, and asphalt samples, as necessary	IV for conventional analytes and V for radiological analytes	• Site Characterization • Evaluation of Remedial Alternatives • Risk Assessment

Table 5.1 Phase I RFI/RI Analytical Data Quality Objectives - continued

Specific Objective (Data Need)	Data Type	Sampling/Analysis Activity	Analytical Level	Data Use
Assess fate and transport of contaminants	Soil and aquifer physical parameters	Evaluate applicability of newly developed aquifer data from adjoining Operable Units and vadose zone data from STP vadose characterization and the OU2 vadose study	I	• Risk Assessment
Assess risk to human health and environment	Data types indicated above	Synthesis of RFI/RI data	I	• Risk Assessment
Identify applicable remedial measures	Data types indicated above	Synthesis of RFI/RI data	I	• Evaluation of Remedial Alternatives

**Table 5.2**  
**(sheet 1 of 2)**

**SAMPLING ACTIVITY OBJECTIVES FOR EACH STAGE OF PHASE I  
REMEDIAL INVESTIGATION**

<b>Activity</b>	<b>Stage 1</b>	<b>Stage 2</b>	<b>Stage 3</b>
<b>Radiation Survey</b>	Screen surface for radiochemical contamination, map anomalies for further subsurface investigation	N/A	N/A
<b>Soil Gas Survey</b>	determine presence or absence of listed analytes in the subsurface, map anomalous areas for further investigation, delineate horizontal extent of contamination	N/A	N/A
<b>Surficial Soils Scrapes</b>	determine presence or absence of listed analytes in the subsurface, map anomalous areas for further investigation, delineate horizontal extent of contamination, begin to develop data for baseline risk assessment	provide additional detail to support the baseline risk assessment, if needed.	provide new information for Feasibility Study if needed.

**Table 5.2**  
**(sheet 2 of 2)**

**SAMPLING ACTIVITY OBJECTIVES FOR EACH STAGE OF PHASE I  
REMEDIAL INVESTIGATION**

<b>Groundwater</b>	<b>determine presence or absence of contamination in existing nearby wells and piezometers</b>	<b>supplement existing wells and piezometers with BAT Hydropunch to develop OU model for Transport and Fate of contaminants</b>	<b>provide additional information if needed</b>
<b>Surface Water and Sediments</b>	<b>establish presence or absence of contamination in the sump at IHSS 171 and at many locations through out the Industrial Area of the plant</b>	<b>provide additional information as deemed necessary from the Stage 1 results</b>	<b>provide additional information as deemed necessary from the Stage 2 results</b>
<b>Boreholes</b>	<b>determine the presence or absence of contamination resulting from subsurfaces releases at IHSSs 128&amp;148</b>	<b>confirm anomalous findings from stage 1, begin to determine nature and extent of contamination in the subsurface</b>	<b>provide additional information as deemed necessary from the Stage 2 results</b>

- **Level II** Mobile laboratories and field gas chromatograph/mass spectrometer (GC/MS) units. Results may be compound-specific and quantitative depending on instrument calibration, reference standards, equipment condition, and operator capability. Real-time data may be available, or results may be produced in several hours. This analytical level is appropriate during the site characterization, evaluation of remedial alternatives, engineering design, and during site monitoring.
- **Level III** Offsite analytical laboratory. Results generally have a greater degree of analytical precision than Level II. Data may be available in 24 hours or in several days to weeks. Level III is an appropriate level for some phases of site characterization, evaluation of remedial alternatives, engineering design, responsible party determination, and during site monitoring. Level III may be appropriate for risk assessment depending on the outcome of RFP policy decisions.
- **Level IV** EPA Contract Laboratory Program methods are required. The analytical precision is similar to that of Level III, but stringent quality assurance and quality control protocol are formally documented. Laboratory turn-around time for reporting analytical results are similar to those described for Level III.
- **Level V** Offsite analytical laboratory using non-standard methods. Analytical method development or modification is required, and analytical precision and reporting schedules may vary according to the method.

Analytical Level I, II, IV and V will be used during implementation of the OU 13 RFI/RI. The analytical methods that will be used are those specified in the EG&G Rocky Flats General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Parts A and B.

Potential contaminants have been identified based upon their toxicity, persistence in the environment, and frequency of occurrence. The potential contaminants present are listed in Table 5.3, but the list is expected to evolve as additional data become available.

Levels of concern are based upon available health standards and are expressed as contaminant-specific concentration ranges that serve as guidelines for selecting analytical methods, detection limits and in determining the boundaries of field investigations.

**Table 5.3**  
**(sheet 1 of 2)**  
**POTENTIAL CONTAMINANTS PRESENT IN OU 13**

<b>IHSS Number</b>	<b>Potential Contaminants Present</b>
117.1/197	plutonium 239/240, radium 226, radium 228, tritium, uranium 233/234, uranium 235, uranium 238, acetone, cadmium, copper, toluene, benzene, carbon disulfide, ethylbenzene, xylenes, strontium 89/90
117.2	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 235, uranium 238, tritium, arsenic, beryllium, cadmium, copper, chromium, lead, mercury, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethene, 1,1-dichloroethane, 1,1-dichloroethene, 1,2 dichloroethene, tetrachloroethene, trichloroethene, 2-butanone, toluene, xylenes, acetone, strontium 89/90
117.3	plutonium 239/240, oils, and solvents
128	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 238, carbon disulfide, and acetone perchloroethene
134	plutonium 239/240, radium 226, uranium 233/234, uranium 235, uranium 238, arsenic, copper, lead, lithium, magnesium, zinc, acetone, toluene, total petroleum hydrocarbons, and solvents
148	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 235, uranium 238, tritium, and nitrates
152	total petroleum hydrocarbons

**Table 5.3**  
**(sheet 2 of 2)**  
**POTENTIAL CONTAMINANTS PRESENT IN OU 13**

<b>157.1</b>	uranium 233/234, uranium 238, PCE, acetone, chloroform, 1,1,1-tetrachloroethane, 1,1-dichloroethane, tetrachloroethene, chloride, beryllium, lead, and mercury
<b>158</b>	plutonium 239/240, radium 226, radium 228, tritium, uranium 233/234, uranium 235, uranium 238, arsenic, chromium, lead, mercury, cadmium, copper, toluene, benzene, carbon disulfide, acetone, ethylbenzene, xylene, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethene, 1,1-dichloroethane, 1,1-dichloroethene, 1,2 dichloroethene, tetrachloroethene, trichloroethene, 2-butanone, and xylenes
<b>171</b>	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 238, carbon disulfide, acetone, and magnesium fuel oil gasoline
<b>186</b>	americium 241, plutonium 239/240, radium 226, uranium 233/234, uranium 235, uranium 238, acetone, benzene, carbon disulfide, ethylbenzene, toluene, xylenes, chloride, and sulfate
<b>190</b>	sodium hydroxide, sulfate, and aluminum
<b>191/169</b>	hydrogen peroxide

Detection limit requirements take into account the levels of concern, RFP chemical-specific Benchmarks in lieu of ARARs, and DQOs specified in the RFP Sitewide Quality Assistance Project Plan (RFP, QAPJP, 1991). Site-specific ARARs will be developed as the initial step in the OU 13 Feasibility Study/Corrective Measures Study. Detection limits are listed in Table 5.4.

#### 5.1.2.4 Identify Data Quantity Needs

Data quantity needs are based on a review of the available environmental data and on the data uses previously described. Data quantity needs are developed in stages as part of the observational philosophy adopted for this project. Simply stated, that approach is based on observing and evaluating the data as work proceeds in stages. Field sampling density is based on a subjective evaluation supported by statistical evaluation. The subjective evaluation includes review of site features to ensure that data are collected at each location where contamination is most likely to have been released.

To ensure that a sufficient quantity of data are collected, the FSAP specifies a three stage approach to data collection. The purpose of Stage 1 is to determine the presence or absence of contamination and to collect sufficient data to efficiently guide data collection in Stages 2 and 3. The purpose of Stage 2 is to confirm Stage 1 findings, and to gather information to define the nature and extent of contamination and to begin to support the baseline risk assessment. The purpose of Stage 3 is to complete the collection of data needed to complete the RFI/RI investigation. Since the data quantity needed in Stage 2 is based on the results of Stage 1 and the data quantity needed in Stage 3 is based on the results of Stage 1 and Stage 2, only Stage 1 data needs will be completely specified in this Work Plan, although the basis for establishing Stage 2 and 3 data needs will be discussed. Table 5.2 defines these objectives for each sampling activity at each stage of the investigation.

The FSAP (Section 6) specifies the objectives and analytic methods for each IHSS for Stage 1. The design of the sampling program is based on the probability of detecting contamination within a given area to a specified level. Each analytic method has its own objective, and is supported by a specific statistical approach.



TABLE 5.4

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS  
FOR SAMPLING ACTIVITIES AT OU13

## TARGET COMPOUND LIST VOLATILES

	Water Limits (ug/L)	Soil Limits ug/Kg
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	1	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
trans-1,2-Dichloropropene	5	5
Bromoform	5	5
4-Methyl-2-pentanone	10	10
2-Hexanone	10	10

Detection limits are identified in the QAPJP.

EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise.

**TABLE 5.4—CONTINUED**

**ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS  
FOR SAMPLING ACTIVITIES AT OU13**

**TARGET ANALYTE LIST METALS**

	Water Limits (ug/L)	Soil Limits (mg/Kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1
Cadmium	5	1
Calcium	5000	2000
Chromium	10	2
Cobalt	50	10
Copper	25	5
Cyanide	5	10
Iron	100	20
Lead	3	1
Magnesium	5000	2000
Manganese	15	3
Mercury	2	2
Nickel	40	8
Potassium	5000	2000
Selenium	5	1
Silver	10	2
Sodium	10	2
Thallium	10	2
Vanadium	50	10
Zinc	20	4
Lithium	100	20

Detection limits are identified in the QAPjP

EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise

**TABLE 5.4—CONTINUED**

**ANALYTICAL PARAMETER AND DETECTION/QUANTTITATION LIMITS  
FOR SAMPLING ACTIVITIES AT OU13**

Anthracene	10	330
Di-n-butylphthalate	10	330
Flouranthene	10	330
Pyrene	10	330
Butyl Benzlyphthalate	10	330
3,3'-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
bis-(2-ethylhexyl)phthalate	10	330
Di-n-octyl Phthalate	10	330
Benzo(b)flouranthene	10	330
Benzo(k)flouranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

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Detection limits are identified in the QAPjP

EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise.

**TABLE 5.4—CONTINUED**

**ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS  
FOR SAMPLING ACTIVITIES AT OU13**

TARGET COMPOUND LIST SEMI-VOLATILES		
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronaphthalene	10	330
2-Nitroaniline	50	1600
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitrophenol	50	1600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenol Phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600

TARGET COMPOUND LIST SEMI-VOLATILES - continued

	Water Limits (ug/L)	Soil Limits (ug/Kg)
N-nitrosodiphenylamine(1)	10	330
4-Bromophenyl-Phenyl ether	10	330
Phenanthrene	10	330

Detection limits are identified in the QAPjP

EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise

TABLE 5.4—CONTINUED

## TARGET COMPOUND LIST VOLATILES

	Water Limits (ug/L)	Soil Limits ug/Kg
Tetrachloroethene	5	5
Toluene	5	5
1,1,2,2-Tetrachloroethane	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Xylenes (total)	5	5

## TARGET COMPOUND LIST SEMI-VOLATILES

Phenol	10	330
bis(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1-3-Dichlorobenzene	10	330
1-4-Dichlorobenzene	10	330
Benzyl Alcohol	10	330
1-2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-Dipropylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic Acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
	Water Limits (ug/L)	Soil Limits (ug/K)
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330

Detection limits are identified in the QAPjP

EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise

TABLE 5.4—CONTINUED

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS  
FOR SAMPLING ACTIVITIES AT OU13

SOIL GAS SAMPLES

Parameter	Detection Limit (ug/l)
Acetone	1
Benzene	1
Carbon disulfide	1
Carbon tetrachloride	1
Chloroform	1
Dichloromethane	1
Ethylbenzene	1
Methylene chloride	1
PCE	1
TCE	1
Toluene	1
Xylenes (total)	1
1,1-DCA	1
1,1,1-TCA	1
1,2-DCA	1
2-Butanone	1

Note Detection limits are a function of the detector type and injection volume. Thus, the detection limit may vary. Target detection limits will be at or below the listed values.

TABLE 5.4

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS FOR  
SAMPLING ACTIVITIES AT OU 13

Other Chemical Compounds		
	Water Limits (pCi/L)	Soil Limits (pCi/g)
<b>Radionuclides</b>		
Gross Alpha, Dissolved	2	4
Gross Beta, Dissolved	4	10
Gross Alpha, Suspended	2	4
Gross Beta, Suspended	4	10
Tritium	400	400
239/240 Plutonium	0.01	0.03
233/234 Uranium	0.6	0.3
235 Uranium	0.6	0.3
238 Uranium	0.6	0.3
241 Americium	0.01	0.02
Total Radiostrontium	1	1
Total Radiocesium	1	0.1
226 Radium	0.5	0.5
228 Radium	1	0.5
244 Curium	1	0.5
237 Neptunium	1	0.5
230 Thorium	1	0.5
232 Thorium	1	0.5
134 Cesium (by Gamma)	1	0.5
127 Cesium (by Gamma)	1	0.5
<b>Anions</b>		
Nitrate	1 mg/L EPA 353.2	5 mg/Kg EPA 353.2
Sulfate	5 mg/L EPA 375.4	10 mg/Kg EPA 375.3
Chloride	5 mg/L EPA 325.2	5 mg/Kg EPA 325.2
Fluoride	5 mg/L EPA 340.2	5 mg/Kg EPA 340.2
pH*	*	*
Specific Conductance*	*	*
Temperature*	*	*
Laboratory Methods for Radionuclides are Identified in Part B of the GRRASP and in the Quality Assurance Addendum for This Work Plan		
* Field Methods OPS-GW 05 (EG&G, 1991c)		

### 5 1.2 5 Evaluate Sampling/Analysis Options

RFI/RI data collection and analysis for OU 13 will utilize a graduated approach in which analytical Level I and Level II field screening techniques will be used to focus subsequent data collection and analysis for analytical Levels IV and V. The sampling/analysis options selected are based upon their ability to obtain data that is consistent with known site conditions. Simply stated the objective for Stage I surveys is to determine if contamination is present in the area being investigated.

Field screening techniques will be used whenever possible to reduce waste generated during sample collection, minimize delays that can result when more exacting analytical methods are used, and to minimize worker exposure. Analytical Level I and Level II field screening will assess both radiochemical and organic chemical contamination during Stage 1 of the FSAP.

5 1 2 5 1 Radiological Surveys using a High Purity Germanium detector (HPGe) or Fidler/NaI detectors will be conducted to survey 100 percent of the IHSS area in order to identify areas of radiochemical contamination on the surface and to map anomalous areas that may require further investigation. Field methods for use of the HPGe are presently being finalized and a standard operating procedure will be incorporated in the Environmental Management Radiological Guidelines Manual (RFP-EMD, 1991a). In areas where it is not practical to use the HPGe equipment, Fidler/NaI detectors will be used to ensure 100% coverage of the area surveyed. Hand held detectors will be employed for health and safety purposes and to screen the sides of buildings or other obstructions which could influence the other detectors. (More information about the use of these detectors is being developed in a paper *Compendium of In-situ Radiological Characterization Methods and Applications* which will be available before field work begins.)



5.1.2.5.2 Soil Gas surveys utilizing a portable GC will be used to identify areas of organic chemical contamination and to direct further sampling efforts. Data collection procedures will be those specified in Environmental Management Division Manual 5-21000, Volume III, Geotechnical (RFP-EMD, 1992a). Two grid spacings are specified—20 feet and 40 feet.

Operational data from recent soil gas surveys conducted at Rocky Flats were utilized in conjunction with a transient subsurface pressure distribution equation (Equation I) to assess the radius of influence of soil gas survey (Johnson, et al., 1990).

$$P' = \frac{Q}{4\pi m(k/\mu)} \left[ -0.5772 - \ln\left(\frac{r^2 \epsilon \mu}{4kP_{\text{atm}}}\right) + \ln(r) \right]$$

where:

- P' = "gauge" pressure measured at distance r and time t
- m = stratum thickness (3 m)
- r = radial distance from vapor extraction well
- k = soil permeability to air flow ( $5.0 \times 10^{-2}$  to  $1.52 \times 10^{-1}$  darcies)
- $\mu$  = viscosity of air ( $1.8 \times 10^{-4}$  g/cm-s)
- $\epsilon$  = air-filled soil void fraction (0.10)
- t = time
- Q = volumetric vapor flow rate from extraction well (0.70 to 0.97 scfm)
- P<sub>atm</sub> = ambient atmospheric pressure =  $1.013 \times 10^6$  g/cm-s<sup>2</sup>.

The results of this analysis indicated that a 10-foot radius of influence was achievable under the operating conditions that may be expected in OU 13. This will result in complete coverage using a 20 foot grid.

A forty foot grid is specified for IHSS where the likelihood of encountering large spills is very high based on past history. For example, Section 2.1 documents the release of approximately 700 gallons of No. 6 diesel fuel at IHSS 152 in 1971. A spill this size would be sufficient to cover an area of approximately 50 feet by 50 feet to a depth of 1/2 inch, which a forty foot grid would

adequately locate. This is especially true because the area of contaminated soil would most likely be much larger

In any event, if contamination is discovered during the soil gas survey, the sampling grid will be expanded to determine the full extent of the contamination. If the sampling effort is extended beyond the current IHSS boundary into an adjacent IHSS, discussion with the appropriate OU manager would be initiated. This will insure that the expanded sampling protocol matches the objectives specified in the relevant work plan.

5 1 2 5 3 Surficial Soils Sampling—As part of the Stage 1 sampling program, surficial soil samples will be taken at specific IHSS areas. The objective of the initial soil sampling plan is to identify elevated concentrations of possible contaminants and to augment the findings of the HPGe survey within each specific IHSS area in OU 13. These samples will be analyzed for TAL metals and a full suite of radionuclides: plutonium 239 and 240, americium 241, uranium 238, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226, radium 228, gross alpha and gross beta. In some cases, specific metals—lithium, beryllium and magnesium will be targeted for analysis at specified IHSSs. One sample per group will be analyzed for gamma-emitting radionuclides with onsite laboratory HPGe instruments. At specific IHSSs where radioactivity has been detected, asphalt samples will also be collected and analyzed for radioactivity with a laboratory HPGe. Laboratory analytical methods will conform to those referenced in GRRASP, these methods meet the criteria for analytical Levels IV and V. Field data collection will be in accordance with Environmental Management Division Manual 5-2000, Volume III, Geotechnical (RFP-EMD, 1992a) (An SOP for the laboratory HPGe is currently under development and will be completed and submitted for regulatory agency approval prior to use.) Sample collection will proceed according to SOP GT.08. Any specific revisions to the procedures will be approved by the regulatory agencies prior to use.

The surficial soils sampling problem is defined as detecting whether contamination is present at each specific IHSS area. The maximum concentration for each constituent will be used to determine if elevated concentrations exist. If elevated concentrations are identified, then more

in-depth borehole and surficial soil sampling will be conducted in Stage 2 to characterize the contaminant and collect additional data to support a human health risk assessment.

The following is the statistical approach used to determine the number of samples to collect. Given  $N$  independent samples, the probability of observing at least one contaminated sample when contamination affects a fraction of the site, is:

$$P = 1 - (1-f)^N$$

WHERE.  $f$  = fraction of site contaminated  
 $N$  = number of independent samples.

The assumptions are that at least 25 percent of the site is contaminated and the samples will be independent. Eleven samples are required to observe at least one contaminated sample with a probability of at least 95 percent within each IHSS group. IHSSs are grouped when their boundaries overlap or they are contiguous in such a manner as to present a discrete area. Table 5.5 shows which IHSSs are grouped together for sampling purposes.

Judgmental sampling, based on historical information and results from the visual and HPGe surveys, will be combined with random sampling to bias the samples to improve detection of contamination. A visual survey will be performed to identify areas where elevated concentrations of contaminants are likely to exist. The results of the visual survey and the HPGe survey will determine the location of surface soil samples. A surface soil sample will be collected at each area where contamination is most likely to exist based on historical information and the visual survey. A surface soil sample will also be collected at anomalous areas identified by the HPGe survey. The remaining surface soil samples will be randomly selected throughout each specific IHSS area using grid points from the HPGe survey. Grid intersections that are located at any of the previously determined sampling locations will be exempted from the random sampling locations.

**Table 5.5**

**Surficial Soil Sampling  
IHSS Groups**

<b>IHSS Group</b>	<b>Number of Samples</b>
117 1 & 197	11
117.2 & 158	11
117.3 & 152	11
148	11
157 1	11
186	11
134S up to but not including 171	11
134 N & 128 & 171	11
<b>Total</b>	<b>88</b>

5.1.2.5.4 Boreholes—A limited number of boreholes will also be drilled during Stage 1 at IHSSs where subsurface release of contamination may be present at depth. The samples from these boreholes will be analyzed for TAL metals, radionuclides, and specific anions.

5.1.2.5.5 Alluvial Groundwater Sampling will continue to be collected during Stage 1 from all existing monitoring wells and piezometers in and surrounding OU 13. This data, historical data from these wells, and new data developed during Stage 1 investigations will be used to locate groundwater sampling activities in Stage 2.

5.1.2.5.6 Additional Activities—After Stage 1 sampling is complete, a technical memorandum will be prepared. The technical memorandum will evaluate the results of Stage 1 sampling and recommend locations for locating boreholes and collecting surface scrape samples. If surficial soil sampling results are not available, they will be reported in a later technical memorandum prior to the commencement of Stage 3 sampling.

Surface scrape samples will be collected during Stage 2 of the FSAP at borehole locations. If a borehole is located in a paved area, the surficial soil scrape will be taken after the pavement is removed. A sample will be taken from directly below the pavement and another taken at either four inches below the pavement bottom, or at the surface of the next soil horizon begins (roadbase/preparation bed soil). (The SOP governing this work is currently being revised. It will be submitted to the regulatory agencies for approval prior to use in the field.) Surface scrape samples will be analyzed for TAL metals, plutonium 239 and 240, americium 241, uranium 238, uranium 235, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226, radium 228, gross alpha, and gross beta. Analytical methods will conform to those referenced in the GRRASP; these methods meet the criteria for analytical Level III through V. Field data collection will be in accordance with Environmental Management Division Manual 5-21000, Volume III, Geotechnical (RFP-EMD, 1992a).

Soil samples will be collected from boreholes during Stage 2 of the FSAP to assess contaminant types and distribution. For those IHSSs where no contamination was detected by Stage 1 activities, a sufficient number of boreholes will be drilled to confirm that there is no contamination.

The number of borings will be proposed in the first Technical Memorandum and will be based on IHSS size, known waste storage history, and possible below ground releases. At IHSSs where contamination was found during the screening surveys, Stage 2 will consist of at least three borings transecting each anomaly (radioactive or other contaminant) downgradient from the point of maximum contamination. This will be done for a maximum of three transects resulting in nine boreholes per IHSS

The need for any additional boreholes can be evaluated in the Stage 2 Technical Memorandum. These additional borings, if required, will be drilled during Stage 3.

An exception to this method of locating boreholes will be made for IHSS 152. Three boreholes will be drilled around the berm surrounding the storage tank, one upgradient and two downgradient. Samples will be analyzed for TCL volatile compounds, TCL semi-volatile compounds, TAL metals, plutonium 239 and 240, americium 241, uranium 238, uranium 235, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226, radium 228, gross alpha, and gross beta. Analytical Level III will be used for the volatile, semi-volatile and metals analyses. Analytical Level V will be used for the radiochemical analyses. Field data collection will be in accordance with Environmental Management Division Manual 5-21000, Volume III, Geotechnical (RFP-EMD, 1992b).

Alluvial groundwater samples will be collected from all existing piezometers and monitor wells in and immediately surrounding OU 13 during stage one of the FSAP. During stage two of the FSAP, alluvial groundwater samples will be collected at the time boreholes are drilled using the Hydropunch® method or equivalent for real time and laboratory analysis. If contamination is confirmed by the soil or groundwater samples, one monitoring well will be installed upgradient of the affected IHSS and one monitoring well will be installed downgradient of the affected IHSS. Samples will be analyzed for TCL volatiles, TCL semi-volatiles, TAL metals, plutonium 239 and 240, americium 241, uranium 238, uranium 235, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226, radium 228, gross alpha and gross beta. Quarterly groundwater data collection from monitoring wells will be conducted as Part of the RFP site-wide monitoring program. Analytical Level IV (CLP protocol) and Level V (for radiochemicals) will be

used for groundwater sample analysis. Groundwater sampling and measurement of field parameters will be conducted in accordance with procedures specified in the FSAP.

All data collection field records will be handled in accordance with the quality control procedures specified in Environmental Management Division Manual 521000, Volume I, Field Operations (RFP-EMD, 1992c)

#### 5.1.2.6 Review of PARCC Parameter Information

PARCC parameters (precision, accuracy, representativeness, completeness, and comparability) for analytical Levels I, II, IV, and V are discussed below. Precision, accuracy and completeness goals are specified in the Quality Assurance addendum for this Work Plan.

Precision is a quantitative measure of data quality that defines the reproducibility or degree of agreement among replicate measurements of a single analyte. The closer the numerical values of the measurements are to each other, the more precise the measurements. One of the methods used to estimate the precision of a method is the standard error of the estimates for the least square regression line of "measured" versus "target" concentrations (EG&G, 1991i). The primary role of this application is to characterize the precision of any analysis method under specified conditions. This allows comparison of different results produced by the same method. Analytical precision for a single analyte may be expressed as percentage of the difference between results of duplicate samples and matrix spike duplicates for a given analyte. Precision will be determined from the results of duplicate and matrix spike duplicate analyses (EG&G, 1991i).

During the collection of data using field methods or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Precision will be reported as the relative percent difference for two results and as the standard deviation for three or more results. Sample collection precision shall be measured in the laboratory with the analysis of field replicates and laboratory duplicates (EG&G, 1991i). Analytical precision will be achieved by adhering to the analytical methods contained in the GRRASP. Sampling precision will be achieved

by conformance the procedures specified in the Environmental Management Division's Operating Procedure manuals referenced above

Accuracy can be expressed in terms of completeness and bias. Accuracy is a quantitative measure of data quality that refers to the degree of difference between measured or calculated values and the true value. The closer to the true value, the more accurate measurement. One of the measures of analytical accuracy is expressed as a percent recovery of a spike or tracer which has been added to the environmental sample at a known concentration before analysis (ERP, 1991). While it is not feasible to totally eliminate sources of error that may reduce accuracy, the OU 13 Work Plan attempts to minimize error by using standardized analytical methods and field procedures.

Representativeness is a qualitative parameter that expresses the degree to which sample data accurately represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition (ERP, 1991). Representative data will be obtained by using both biased and unbiased methods of selecting sample locations. Biased methods will employ existing data in areas known to be contaminated to determine the degree of contamination. Unbiased methods such as grid sampling will be used to determine both the nature and extent of contamination. Field work will be conducted according to standard operating procedures, further aiding the collection of representative data.

Completeness is a quantitative measure of data quality expressed as the percentage of valid or acceptable data obtained from a measurement system. The objectives of the field sampling program are to obtain samples for all analyses required at each individual site, to provide sufficient sample material to complete those analyses, and to produce QC samples that represent all possible contamination situations such as potential contamination during sample collection, transportation, or storage (EG&G, 1991).

Comparability is a qualitative parameter describing the confidence with which one data set may be compared to another (EPA, 1987). The standard laboratory methods of the GRRASP and standard operating procedures for conducting field work will allow for one to one comparability of OU 13 RFI/RI data to other work conducted in conformance with those same standards.



### 5.1.3 Stage 3 - Design Data Collection Program

Stage three of the DQO process compiles the various elements of Stages one and two into a cohesive data collection program for the OU 13 RFI/RI. To this end, a Field Sampling and Analysis Plan and Quality Assurance/Quality Control Plan have been developed and are included as Sections 6 and 10, respectively, of this Work Plan. The results of the DQO process have been distilled into a detailed list (Table 6.1) of the number and type of samples to be collected, their location, and analytical methods.